MOBILE EXPERTS

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# *Slowing Down the IoT Standards Frenzy*

**Introduction**

It sounds like a joke… when we talk about 20-year battery life for NB-IoT devices, but at the same time industry standards groups work feverishly to update Cellular IoT standards to 5G. Many people simply laugh at the joke and move on. This brief report is intended to examine the underlying drivers behind this inconsistent behavior… and to understand what it really means.

**Why does 3GPP release new standards every 18 months?**

First, let's understand why the cellular world has developed the habit of updating its wireless format on a regular schedule. It's a huge investment of time and money across the industry to develop a standard, because so many steps are involved:

- A company will propose a study item in a 3GPP committee;
- Dozens, if not hundreds of companies will perform testing and provide information to the group in support of the study item;
- The study item is promoted to be a 'work item' ;
- Again, at least 10 different companies will develop prototype hardware, perform testing, and simulate performance. A typical work item can entail thousands of man-hours of engineering time for each participating company.
- Finally, after data has been distributed to the entire committee, a vote will take place to finalize the requirements for a new feature.

Large market participants such as Huawei, Ericsson, Qualcomm, Intel, and others have senior engineers that are dedicated full-time to supporting the standards process, because they perceive benefits for the company in driving the standards to suit their company's unique IP portfolio.

Each new release of the 3GPP standards entails hundreds of work items, backed by uncounted millions of man-hours of engineering study. Mobile Experts estimates that each release of a 3GPP standard costs the industry roughly $400M in engineering time alone, plus billions of dollars related to retooling, updating chipsets, writing software, and other changes related to the products themselves. The total cost for the industry to support a new 3GPP standard totals at least $2B.

Why does the industry choose to keep spending this money? Because the mobile broadband market still needs improvements in performance to keep generating profit.

The mobile operators bring in over $1 Trillion per year in revenue, and they are continuously stretched by capacity demand in key urban areas. The industry is trying to support the need for higher capacity with limited spectrum, which means that continual improvements to spectral efficiency are necessary.

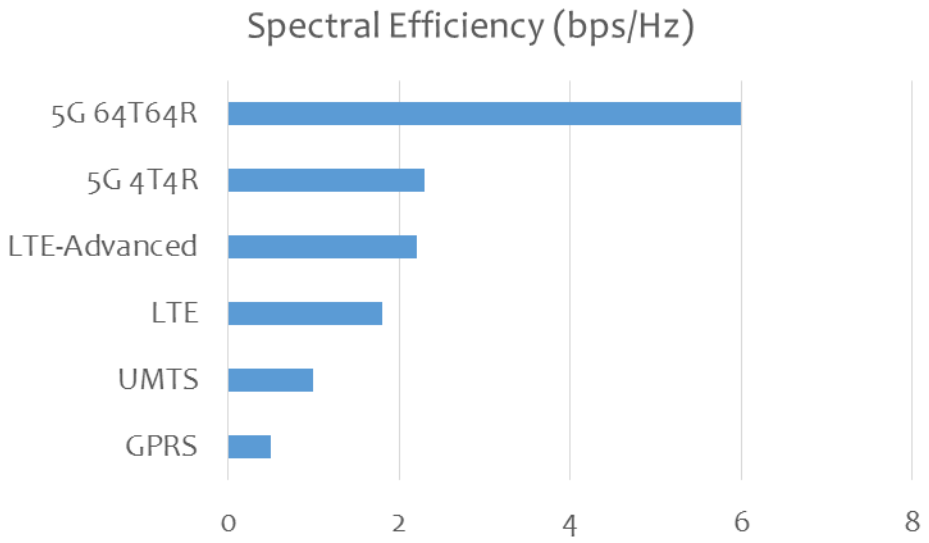


**Figure 1: Spectral Efficiency for successive generations of mobile technology**

Sources: Mobile Experts

The point of improving spectral efficiency has been to improve the cost of delivering data. Over the years, the improvement in spectrum usage has directly related to decreasing cost for delivering content to end users.

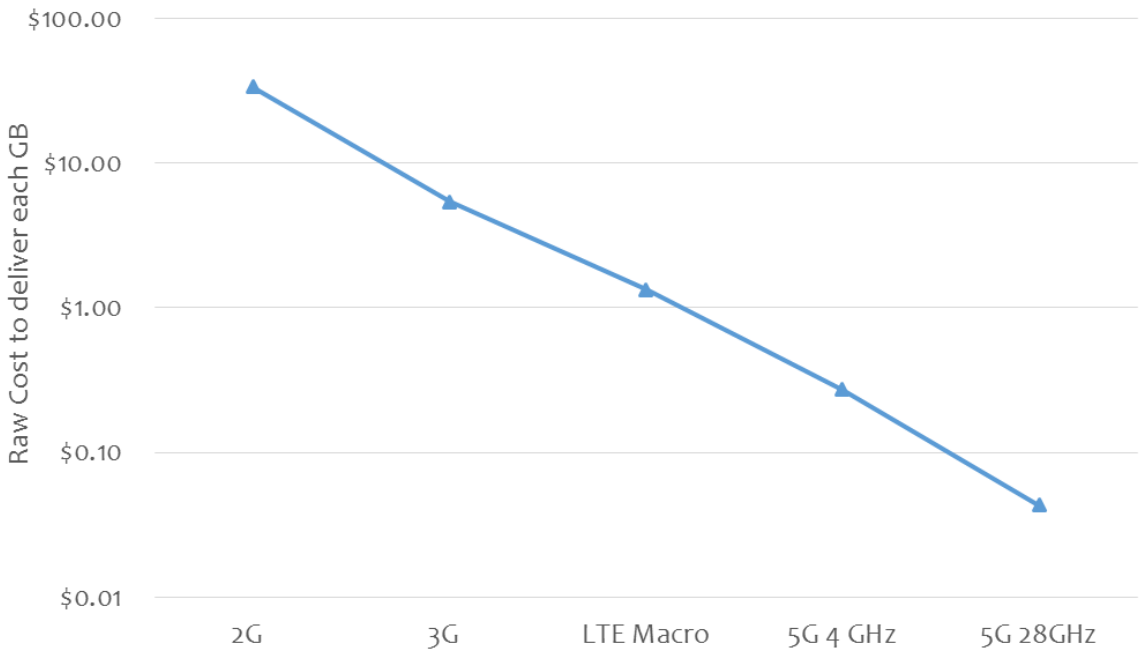


**Figure 2: Cost Reduction resulting from standards evolution**

Sources: Mobile Experts

In the simplest way of looking at the mobile market, it comes down to this: Competition for the consumer drives down the price per GB rapidly, so new technology is necessary to drive down cost per GB even faster. If the mobile industry creates net profit of $100-200 billion annually, then investing $2B in updates to the wireless standard is sensible.

**IoT is Different**

In the smartphone market, people generally replace their devices every 3 years. The average time was 18 months to 2 years in 2010, but over the past 8 years a few factors have slowed down the replacement cycle for phones, including waterproofing, "gorilla glass", and general apathy about new features on recent phones.

In the IoT market, however, the "replacement cycle" for a device is much longer:

- A smart meter is expected to remain in place for 40 years.
- A streetlight and related connectivity is expected to last for 50 years.
- The automotive design cycle is roughly 7 years, with a 20+ year life for the car.

- Industrial operations make investments with 10-year to 20-year expectations for longevity, and longer in some cases.
- Asset tracking platforms need a stable connectivity format, as they build economy of scale over long periods of time and it's not easy to change out individual devices.

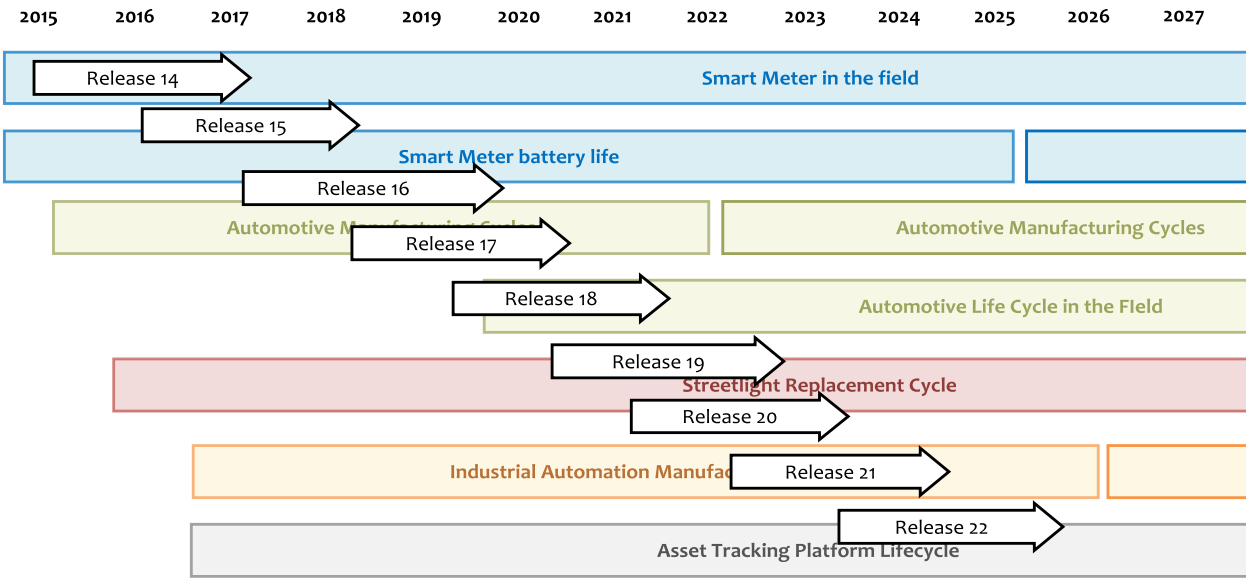


**Figure 3: Comparing the 3GPP cadence to the timing of IoT markets**

Sources: Mobile Experts

Looking at these IoT applications and the priorities of the end customers, it's clear that changing wireless standards every 18 months would be ridiculous. In Figure 3 (above), we display a hypothetical case where 3GPP continues to release new changes to the wireless format every 18 months through 2026. The mobile industry could conceivably update the standard 10 times before a smart meter even needs a new battery.

**The Economics of IoT are Different**

The smartphone market constantly needs updated standards to drive spectral efficiency, because profit is tied to improvements in cost per GB. Spectral efficiency is critical to profit. However, in the IoT market, the cost to deliver each kB of data is less important than the scale of how many IoT customers are served. Because Cellular IoT lives on top of the broadband network, the capacity load that it presents to the network infrastructure is meaningless. Instead, the most important factor is driving large numbers of devices….directly adding revenue without a meaningful marginal cost.

As one example, the AT&T "LTE-M Button" addresses a collection of simple use cases that are typical in the Cellular IoT market. AT&T offers this "button" to indicate simple status, such as a full tank, or an open door, with a three-year battery and a price of $29.99. Assuming one or two changes in status each day, the button product line represents about $60 of revenue for every MB of data served. The marginal cost of delivering the data over the LTE network: Only about $0.001 per MB. So, it's clear that trying to reduce the cost of data payload is meaningless in the IoT market.

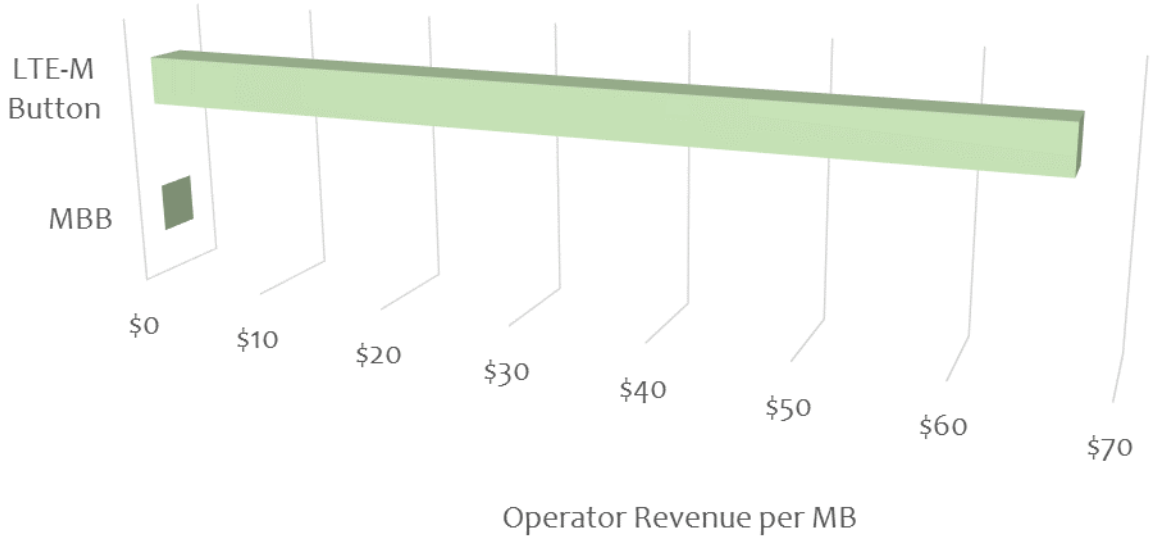


**Figure 4: Revenue per MB for the LTE-M Button**

Sources: AT&T, Mobile Experts

**What do IoT customers want?**

After three years of investigation, we can report that Cellular IoT customers are typically enterprises with plans to reduce cost of operations in some way. In fleet management, smart metering, asset tracking, and other applications, these customers are not concerned about data speed, latency, or spectral efficiency. They care about cost, coverage, and longevity.

We've addressed cost and coverage in many different ways in the past. Recently, in discussions with manufacturing managers, water companies, streetlight project

managers, and other key IoT customers, we have noted that there's a definite lack of trust. These customers don't trust the mobile operators to continue supporting an IoT standard for 40 years….because they've already been burned by the GSM shutdown in the USA and other similar issues with mobile support in the past.

It's critical for the mobile industry to send a loud message that IoT is separate and different than the main smartphone business, with a clear definition of HOW they can guarantee that they'll support the smaller IoT revenue stream when the smartphone market shifts to something else.

**Cost Analysis**

Looking at Cellular IoT devices, the primary factor impacting cost is the economy of scale. Producing one million devices--then moving on to another format with a new chipset to produce another million devices—doesn't work in the IoT economic model. A typical IoT device OEM will spend about $2M developing a product, including the cloud platform, user interface, and connectivity. Let's assume that $500K is devoted to developing the IoT device itself, inserting a module into a plastic box that includes a sensor, a battery, and a small compute platform with unique software. If the OEM only produces one million devices before re-designing the wireless chain again, then the $500K is spread over one million devices, for a fixed cost of $0.50 per device. However, if the wireless design can be used for ten years, even without market growth the fixed cost drops to five cents.

Similarly, at the chipset level, a great deal of the cost is related to the tapeout of a modem. A $100M investment in a NB-IoT modem means that each modem shipped carries a fixed overhead cost of $5, if the company produces 20 million modems over two years. The market demands that a NB-IoT module must cost about ***$5 or less in total,*** so this fixed cost is clearly unreasonable. This is the reason that the Chinese government is heavily subsidizing NB-IoT chips in China right now. Chinese subsidies are allowing HiSilicon to produce NB-IoT chipsets with a small profit, but we don't believe that they make the level of gross margin necessary for a minimal net ROI (indicated by green in our simple diagram).

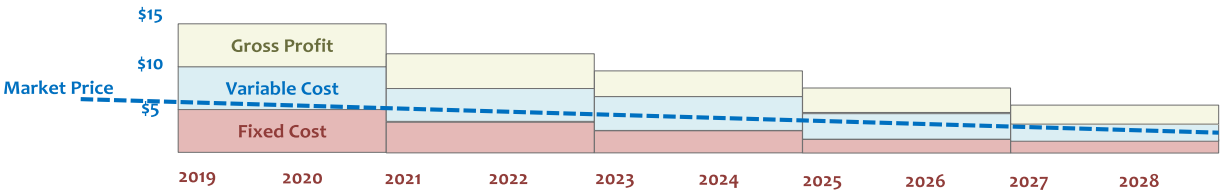


**Figure 5: Simplified cost picture per NB-IoT chip, with redesign every 2 years**

Source: Mobile Experts

If the market can settle into using a single format for ten years, however, the economics can change dramatically. Suppliers that don't have to recoup their fixed investment in the first two years can be more aggressive in pricing, expecting their fixed costs to be covered over a 5-10 year period instead. The tape-out cost of a NB-IoT modem can drop to $1 per modem if it's spread over 10 years… so that a chip supplier can make a decent profit.

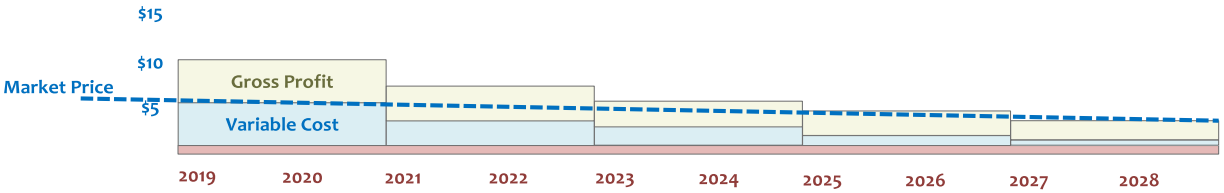


**Figure 6: Simplified cost picture per NB-IoT chip, with redesign every 10 years**

Source: Mobile Experts

Note that if the chip vendor can spread its investment over 10 years, in addition to reduced fixed overhead the product is likely to see greater improvement in variable costs. The cost to produce a chip is heavily dependent on economy of scale, running 12" wafers and producing large numbers of chips all together. If inventory overhang is not looming over a vendor, then manufacturing can be more efficient. In this scenario, we believe that a 50% gross margin will be possible for a NB-IoT chipset.

## Conclusions

Overall, it's clear that the mobile industry is continuing to spend money developing new standards for IoT. There's no single person in charge that can say "Okay guys, let's suddenly change our product life cycle from two years to 10 years". So, the transition

will be painful as individual companies try to stay competitive and avoid missing a market shift to a new standard.

As a result, for the next 3-4 years we expect to see the IoT market hindered by high prices for chipsets and by uncertainty among the customer community. Of course, the market is growing but we believe it could grow much faster.

If the mobile industry can somehow shift its direction to clearly define a standard for a decade or more, then enterprise customers will feel more comfortable and suppliers can reach better economies of scale.